Ultrasonic Wall Measurement and MFL Run Comparison

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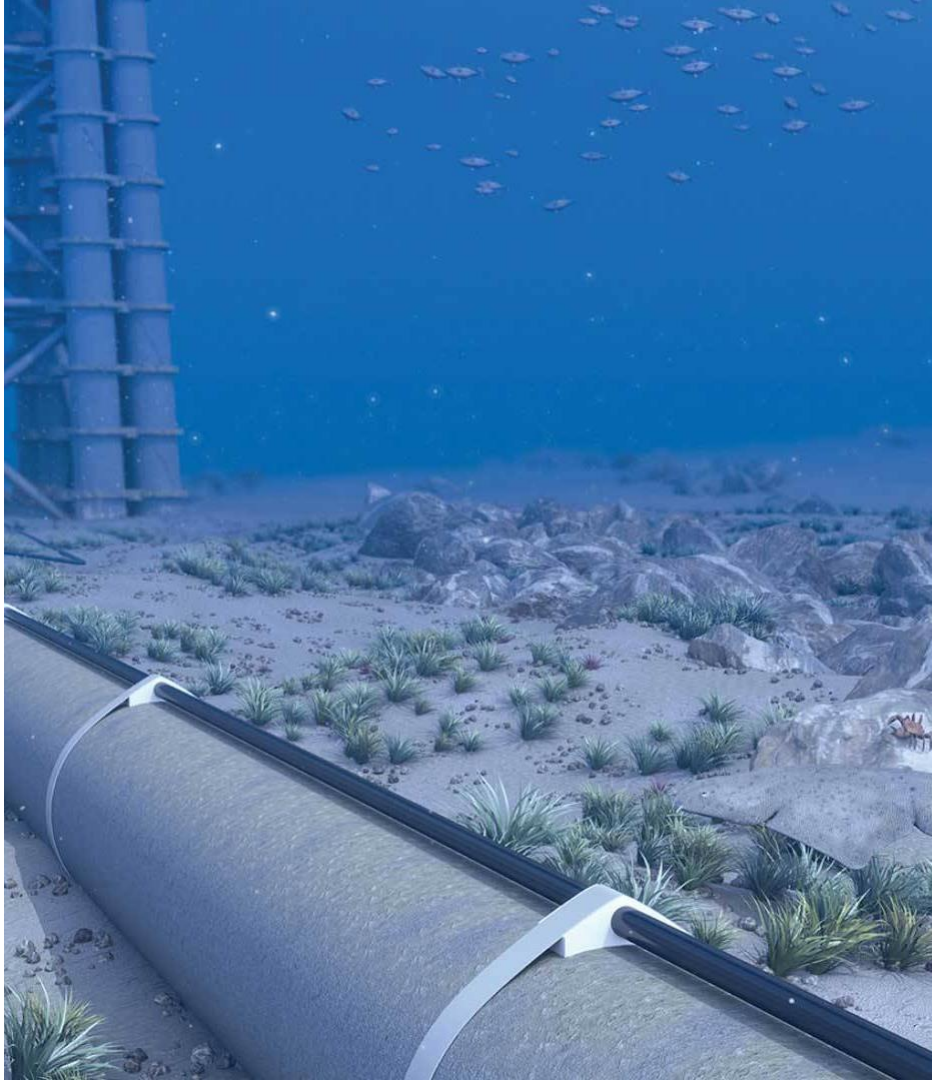
NDT Global

Today’s Agenda

Welcome and introductions

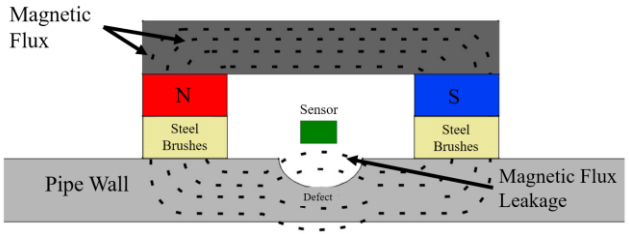
- Case study: offshore pipeline
  - Internal pitting and long axial corrosion
  - Inspected continuously with MFL
  - Inspected with UT following a leak
- Benefits and challenges of MFL v UTWM
- Comparison of results
- Utility of customized deliverable
- Application of a custom assessment method for long-axial internal corrosion (DNV-RP-F101 Appendix D)
- Questions



Inline Inspection Tools

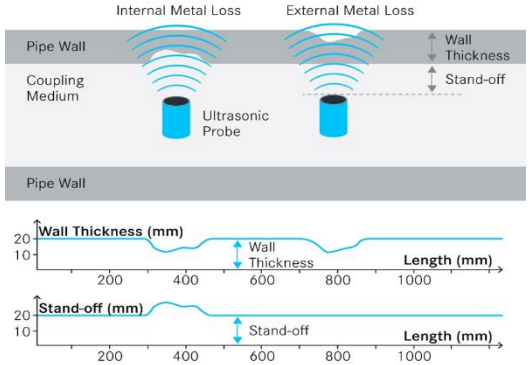
Magnetic Flux Leakage (MFL)

- Relative measurement (indirect)
- Orientation of magnetic field affects measurement
- Does not require couplant
- Minimum measurable pitting width: 6.0 mm with 90% POD



Ultrasonic Technology / UT Wall Measurement (UMp)

- Pulse echo – Ultrasonic Wall Measurement
- Direct measurement
- Requires couplant
- Minimum measurable pitting width: 5.0 mm with 90% POD

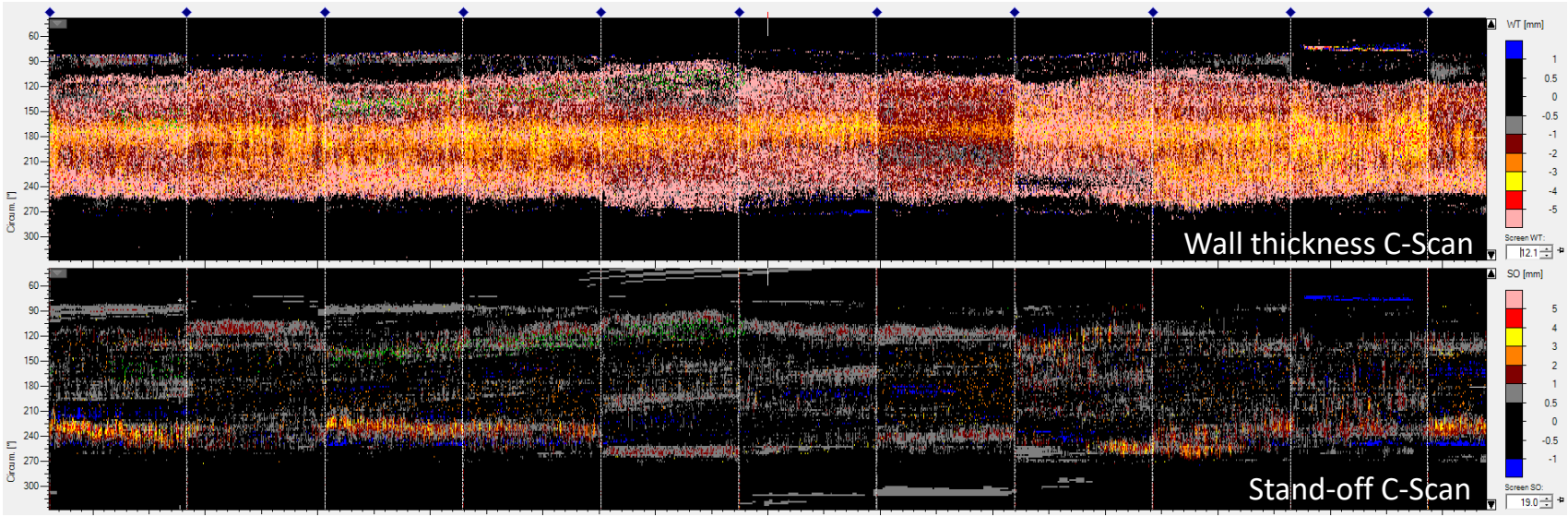


Direct measurement = constant sizing tolerance

Wall thickness	Sizing accuracy MFL	Sizing accuracy UT
6.0 mm	±0.78 mm	±0.4 mm
7.0 mm	±0.91 mm	±0.4 mm
8.0 mm	±1.04 mm	±0.4 mm
9.0 mm	±1.17 mm	±0.4 mm
10.0 mm	±1.30 mm	±0.4 mm

Sizing accuracies for different wall thicknesses.

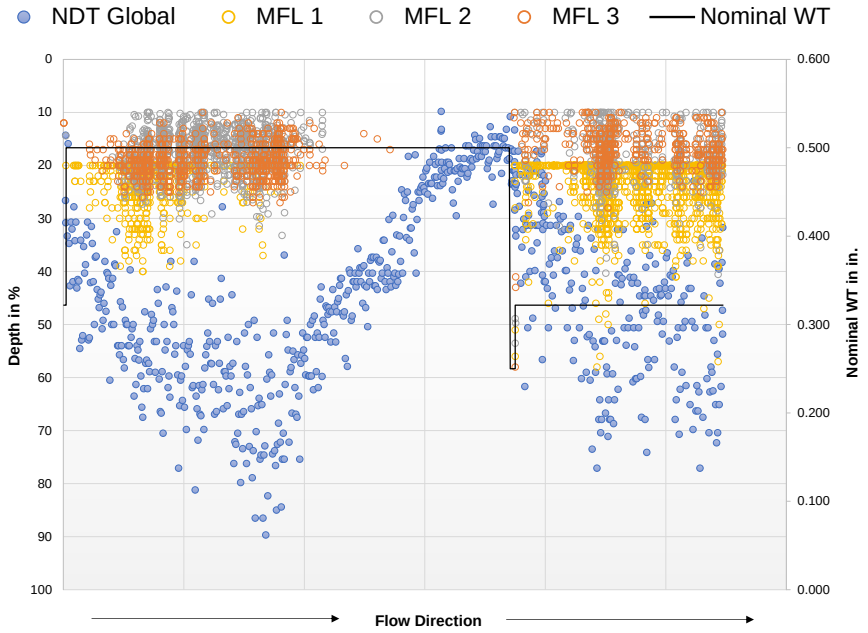
Long axial corrosion measured by UMp



- Coherent long axial corrosion across 10 pipe joints (~410 ft, 125 m)
- Deep areas of metal loss within the affected wall

MFL and UMp Results Comparison

- Three different MFL vendors
- All axial MFL inspections
- All four ILI results cover the long axial corrosion
- No MFL results match the deepest UMp points
  - Confirmed with NDE by the operator
- MFL 2 and MFL 3 have similar results; MFL 1 falls in between
- Wall thickness has an impact on data recording



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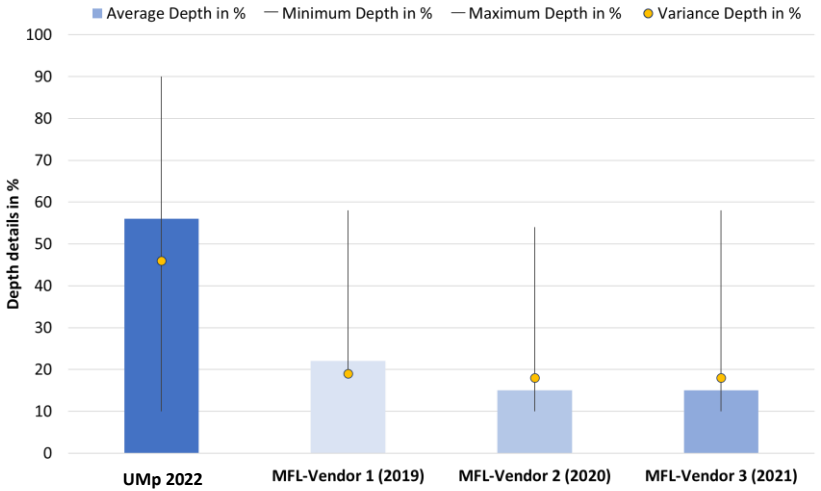
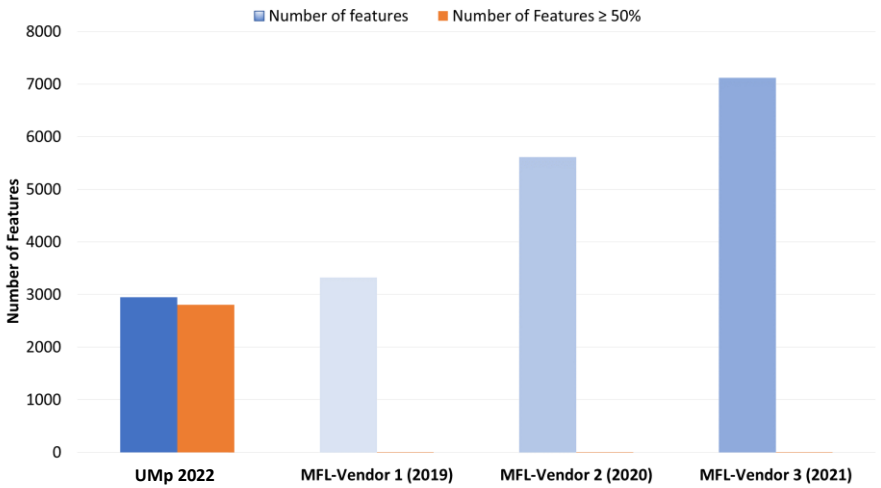
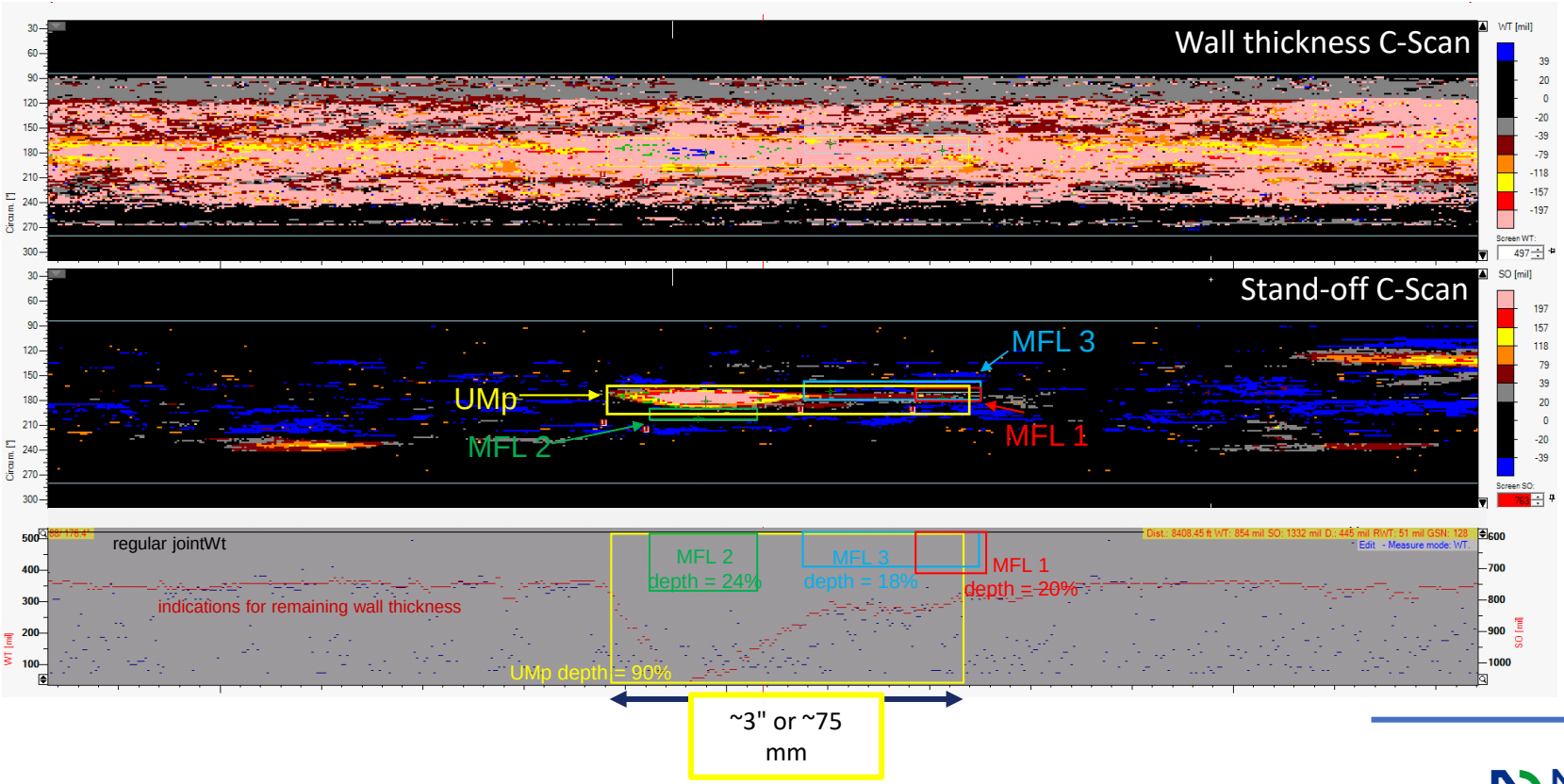




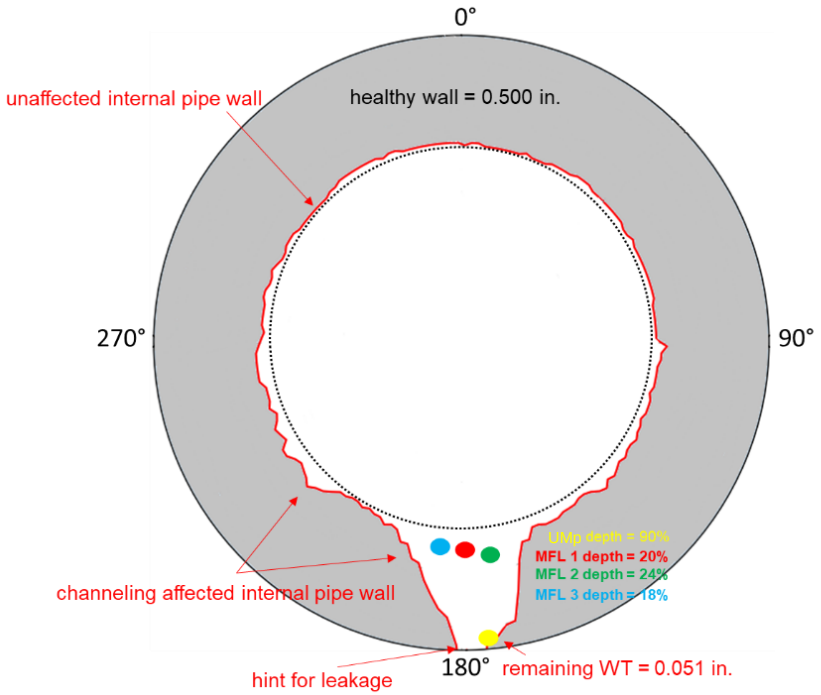
- UMp recorded a wider array of percent depths and a larger average depth
- All 3 MFL inspections recorded an average feature depth ~20 %
- MFL and UMp typically record different numbers of features

A Look at the Deepest Point in UMp Data

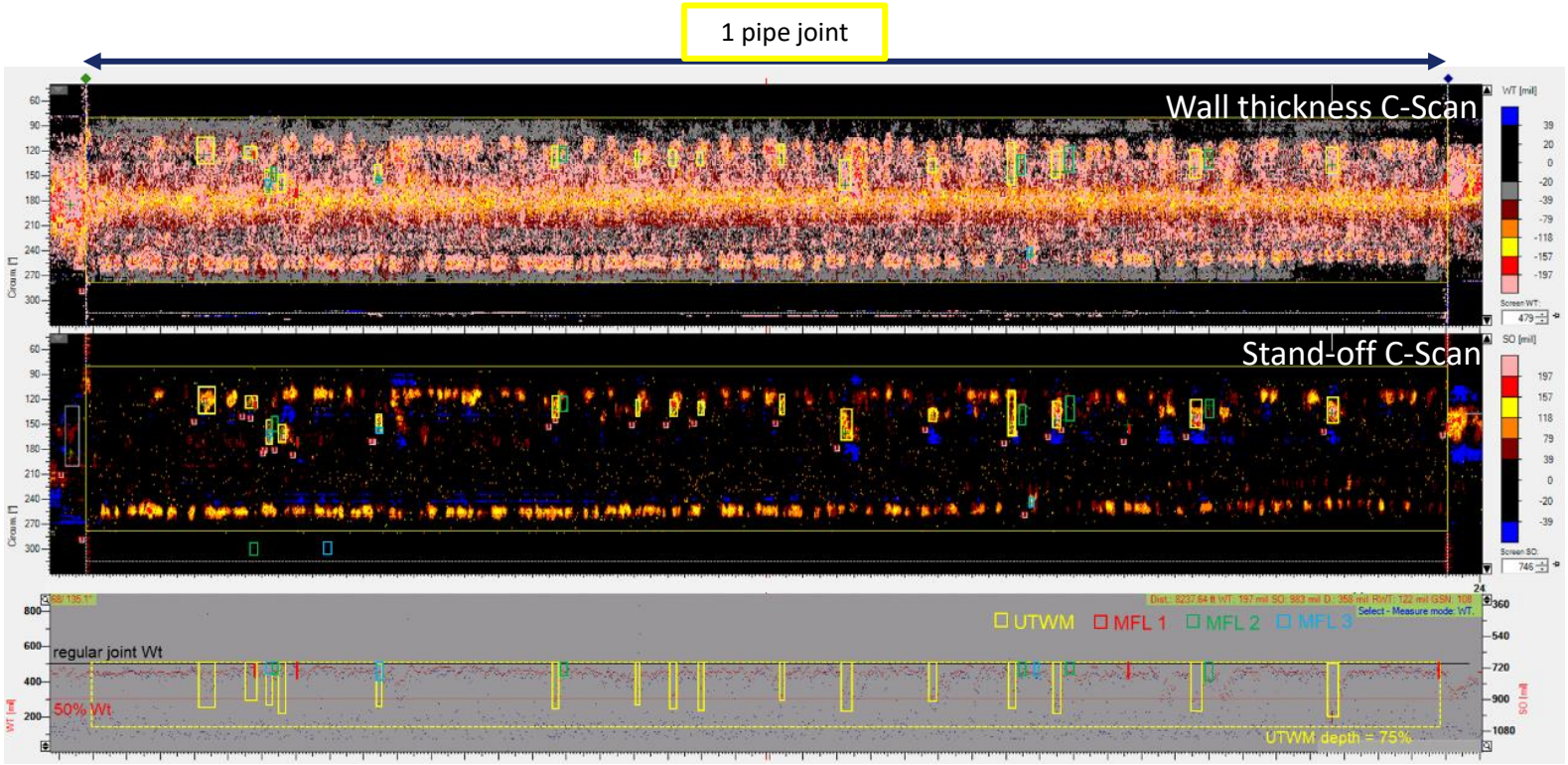


A Look at the Deepest Point in UMp Data

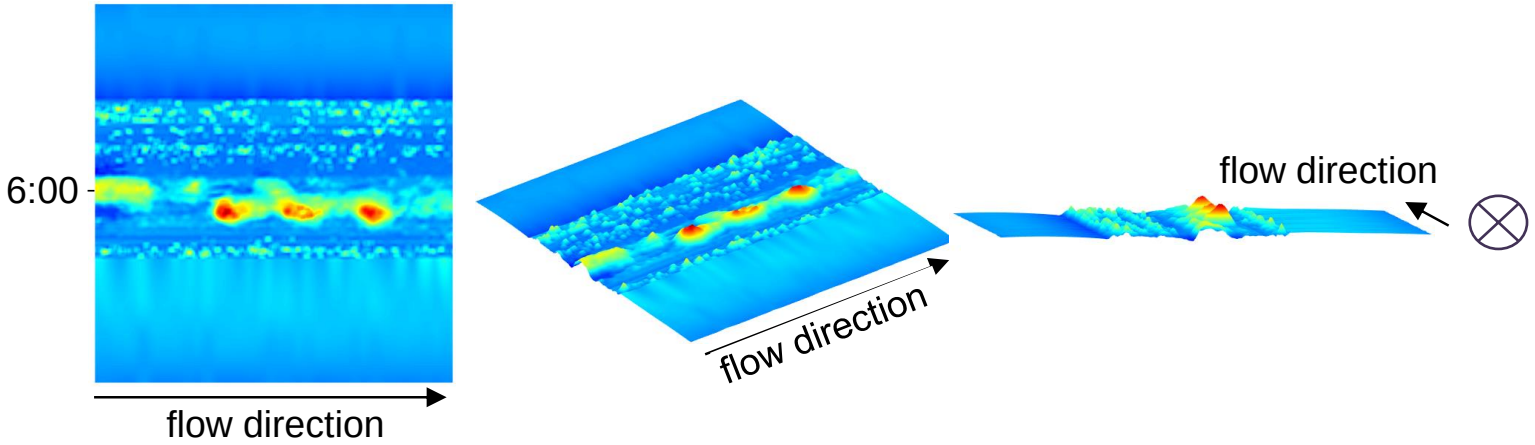
- MFL measurements focus on the shallow long axial corrosion
- Depth of MFL points close to local wall thickness
- Long axial corrosion obscured axial MFL measurement



A Look at Features within Long Axial Corrosion in UMp Data



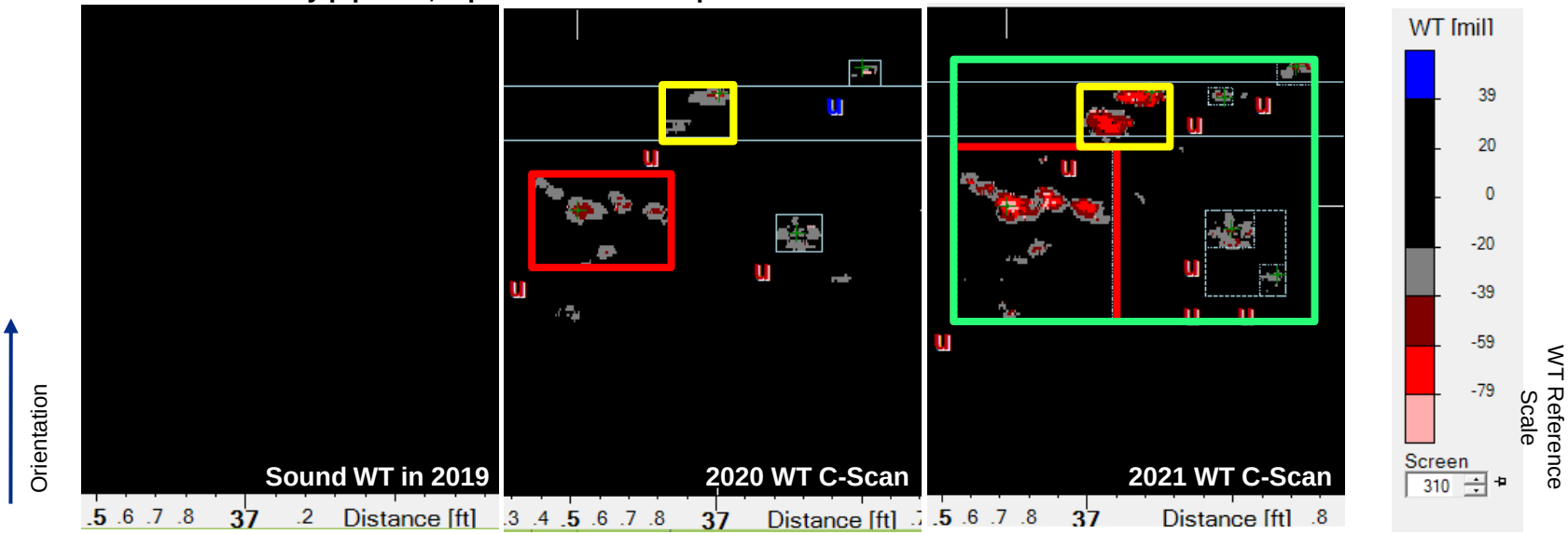
Topography of Metal Loss from UMp Data



- Shape of internal corrosion clearly visible
- 3 distinct bands of corrosion across the circumferential direction
- 6 o'clock band has large, deep pits
- Bands on either side of 6 o'clock have many smaller, shallower pits

Precise corrosion monitoring

***Not the case study pipeline; representative example**



Assessment of Long-axial Corrosion: DNV-RP-F101 Appendix D

- Assessment method for pipelines with long axial corrosion

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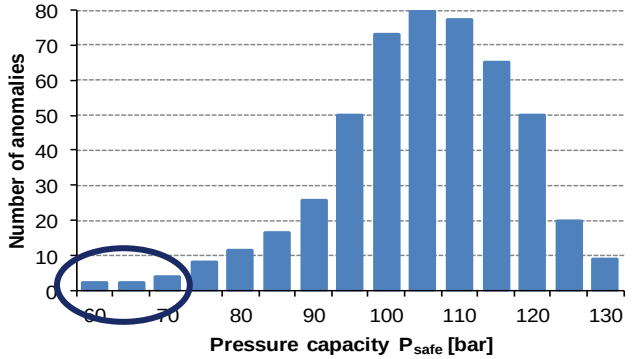

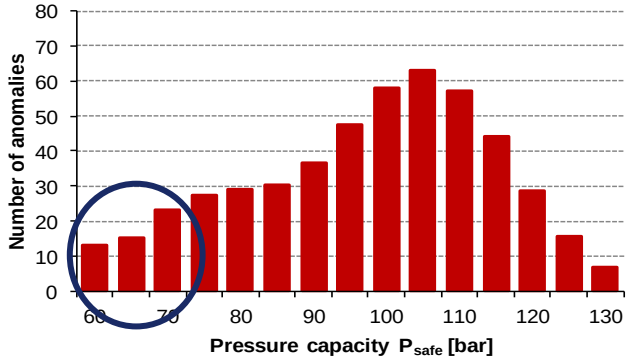

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- Assessment method for pipelines with long axial corrosion
- Main steps:
  - ✓ **Construction of river-bottom profiles**

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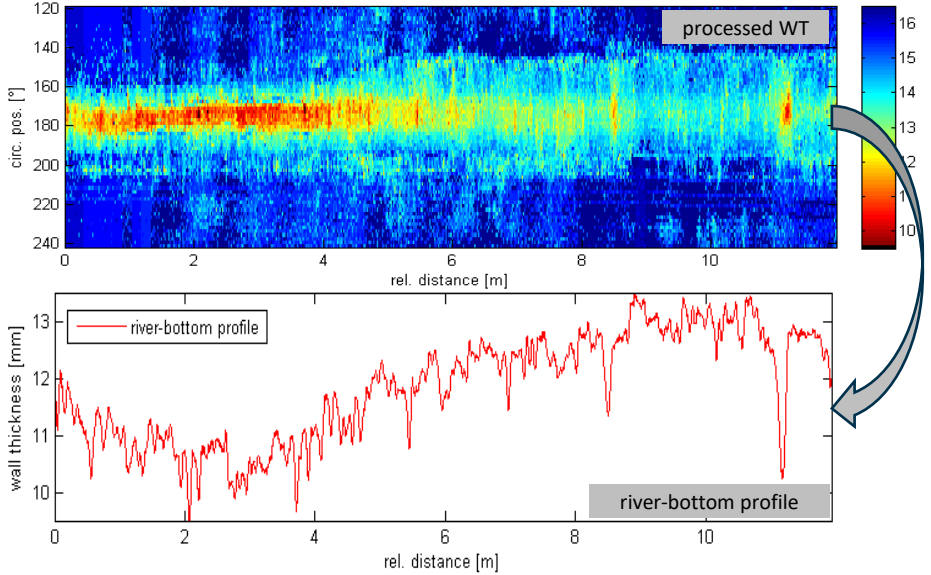

Assessment of Long-axial Corrosion: DNV-RP-F101 Appendix D

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  - ✓ **Calculation of pipeline pressure capacity based on POF**

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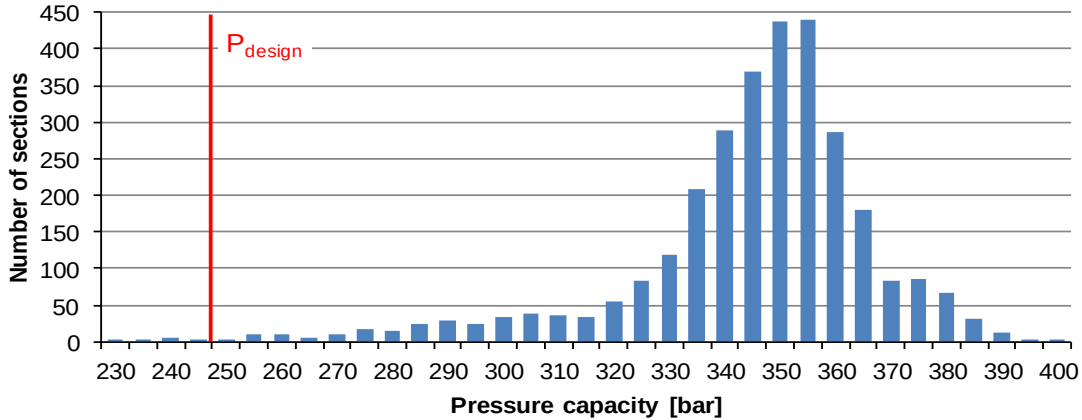

P safe, worst joint = 231 bar

P safe, system = 223 bar

Assessment of Long-axial Corrosion: DNV-RP-F101 Appendix D

- Assessment method for pipelines with long axial corrosion
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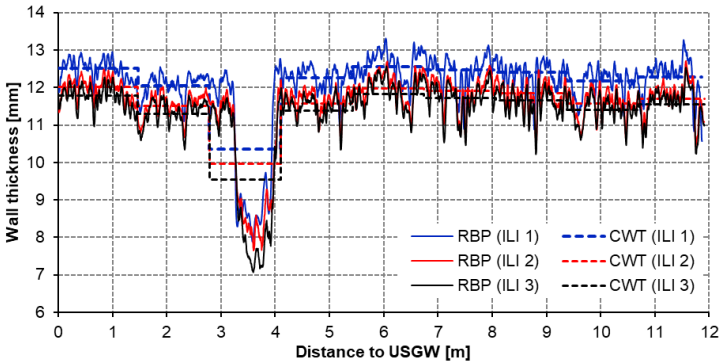
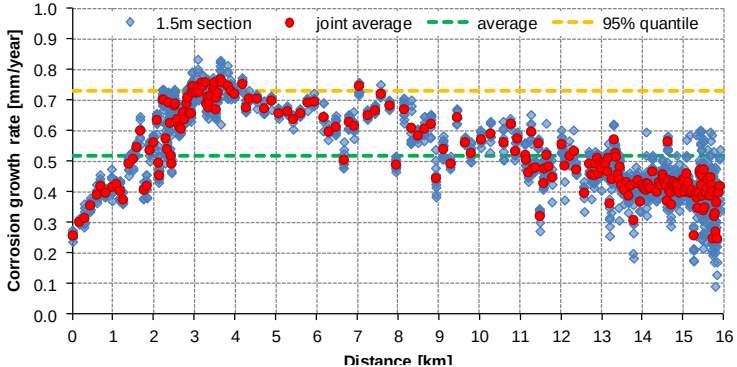
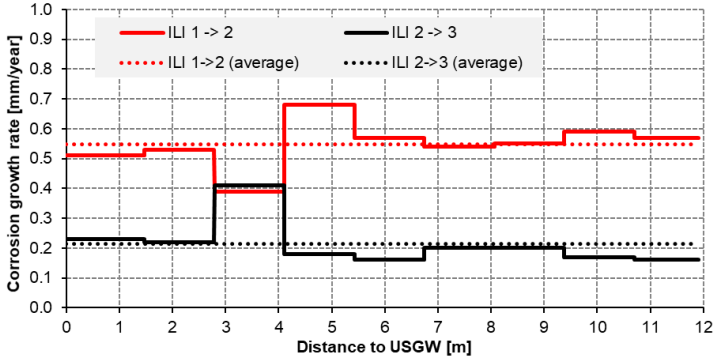
  - ✓ Calculation of pipeline pressure capacity based on POF
  - ✓ **Corrosion growth assessment**







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- Assessment method for pipelines with long axial corrosion
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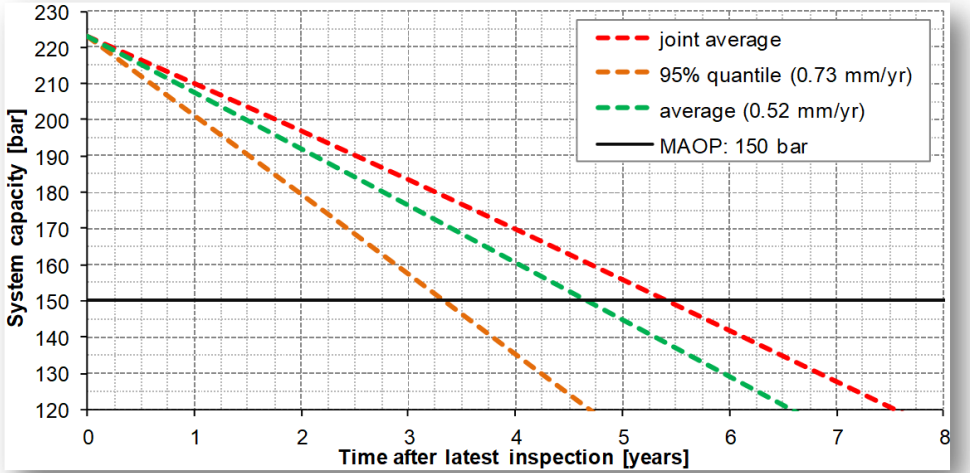
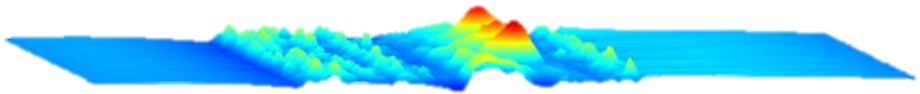
  - ✓ Calculation of pipeline pressure capacity based on POF
  - ✓ Corrosion growth assessment
  - ✓ **Extrapolation of pressure capacity**



***Not the case study pipeline; representative example**

Summary and Conclusions

- Managing the integrity of assets by means of ILI is possible, however **choosing the right technology for the inspection is crucial**
- MFL can be less costly and does not require extensive cleaning; however relative measurement and magnetic field orientation can make application tricky
- UMp can provide repeatable, direct measurement under challenging conditions (like pitting within long axial corrosion); however proper cleaning is required
- In the application presented here, UMp was able to provide accurate corrosion topography where 3 different MFL vendors could not
- UMp enables the application of DNV RP-F101 Appendix D, to calculate the pressure capacity of a pipeline considering the system effect



Topography of metal loss from UTWM data

Thank You!

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